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How day of posting affects level of critical discourse in asynchronous discussions and computer-supported collaborative argumentation

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Abstract

In asynchronous threaded discussions, messages posted near the end of the week provide less time for students to critically examine and respond to ideas presented in the messages than messages posted early in the week. This study examined how the day in which messages are posted (early, midweek and weekend) in computer-supported collaborative argumentation affect the number of responses elicited by arguments and challenges, and how its effects differ across the four types of exchanges (argument–challenge, challenge–counterchallenge, challenge–explain, challenge–evidence) that serve as indicators of critical discourse. This study found that the day of posting had a significant effect on the number of responses elicited per message, with the greatest to smallest effect on argument–challenge, challenge–counterchallenge, challenge–explain and challenge–evidence exchanges respectively. These findings highlight some of the limitations of asynchronous discussions, and suggest alternative ways to implement and design discussion environments to promote higher levels of critical discourse.

Introduction

Computer-mediated communication (CMC) is widely used in distance learning (Harasim, 1993) to support student–student interaction and online group discussions. Threaded discussions enable students to participate asynchronously by posting messages to multiple and concurrent topics of discussion at any time and from anywhere.

Students can read, reflect, compose and post responses at their own time and convenience. Most of all, students can revisit, build on and respond to messages from earlier threads and not just from the current threads. These characteristics are believed to generate higher levels of critical thinking and generate ideas that are more important, justified and linked than in face-to-face or synchronous discussions (Newman, Johnson, Cochrane & Webb, 1996). Like CMC, computer-supported collaborative argumentation (CSCA) provides students with opportunities to practise critical thinking through argumentation, using text-based communication tools (Baker, 1999) that constrain the types of messages and responses students can post to a discussion (eg, arguments, explanations and challenges). These constraints are intended to help students apply transactive reasoning to test out uncertainties, extract meaning, achieve deeper understanding, and to investigate and evaluate evidence and alternative arguments (McAlister, Ravenscroft & Scanlon, 2004). This and similar approaches have been implemented in other systems like CSILE (Scardamalia & Bereiter, 1996), ACT (Sloffer, Dueber & Duffy, 1999), Hermes (Karacapilidis & Papadias, 2001), and FLE3 (Leinonen, Virtanen, Hakkarainen & Kligyte 2002).

However, one disadvantage of CMC and CSCA is that students must often wait for replies for several hours or days—waits that inhibit the momentum and flow of discussions. Students also face the cognitive challenges of having to simultaneously monitor and participate in multiple concurrent discussion threads. Hewitt and Teplovs (1999) found that responses posted to a message within 24 hours resulted in a 0.63 probability of eliciting a reply. After 1 and 2 days of inactivity, the odds of eliciting replies dropped to 0.41 and 0.31 respectively. What may be contributing to the observed decreases in response probabilities is the progressive increase in the number of concurrent threads and messages competing for the students' responses (Hewitt, 2003). Although Jeong (2004) reported similar findings—where the odds of eliciting a reply dropped by 17% for each day of inactivity—this study observed longer response latencies in replies that challenged claims presented in previous messages, and that despite their longer response latencies, challenges elicited significantly more replies (not less replies) than other types of messages. One explanation for this finding was that the conflict produced by challenges helped to trigger and drive further inquiry (Koschmann, 1996), and compensated for the long response latencies.

Other disadvantages that result from the late (vs. early) posting of messages in a discussion period include the following: (1) students have fewer days to respond and build on ideas posted in later messages (*time limitations*); (2) messages posted late in the discussion period must compete for students' attention against a larger number of messages than messages posted early in the discussion (*split attention*); (3) assuming that the number of messages students are able or willing to post is limited in number (*limited resources*), the potential number of new replies posted to the discussion dwindles in number with each passing day; and (4) new messages, which are often presented close to or at the bottom of a discussion forum, are not as visually prominent and hence may be less likely to elicit responses than messages posted early and to be displayed more prominently at the top of the discussion forum (*visual prominence*).

At this time, no reported studies have examined how messages posted early versus later within a fixed discussion period affects the growth patterns of threads, particularly the patterns that promote critical discourse (eg, argument–challenge–explain vs. argument–no response). Determining the effects of messages posted early versus later can provide critical information that might help us identify strategies (or generate justifications for using particular strategies) that promote deeper inquiry and more critical discourse in asynchronous discussions—strategies like establishing deadlines to identify discussion topics and deadlines to complete discussions on specified topics (Farnham, Chesley, McGhee & Kawal, 2000), conducting discussions over longer periods of time (eg, a 2-week vs. 1-week period) to eliminate the logistical challenges that multiple deadlines might impose on distance learners, who require more flexibility in their weekly schedules (eg, study on weekends only), posting topics or arguments *in advance* so that all threads begin at the same point in time, and restricting students' ability to create new threads within a discussion forum (Brooks & Jeong, 2006).

Theoretical framework

To examine how the level of critical discourse is affected by messages posted early versus late within a fixed discussion period, this study analysed the number of responses generated by messages across four types of exchanges (argument–challenge, challenge–counterchallenge, challenge–explain and challenge–evidence). These exchanges are believed to trigger and serve as key indicators of critical discourse based on the assumptions of the dialogic theory of language (Bakhtin, 1981; Koschmann, 1996). The dialogic theory presumes that: (1) conflict is produced not by ideas presented in one message alone, but by the juxtaposition of opposing messages (eg, argument–challenge, challenge–counterchallenge), and (2) conflicts produced in these exchanges help to trigger subsequent responses that serve to dismiss or rebuke a challenge (eg, argument–challenge–counterchallenge), or verify (eg, argument–challenge–evidence) and justify (eg, argument–challenge–explain) arguments. Support for this theory can be drawn from previous research on collaborative learning that shows that conflict and the consideration of both sides of an issue are needed to drive inquiry, reflection, articulation of individual viewpoints and underlying assumptions, and to achieve deeper understanding (Baker, 1999; Johnson & Johnson, 1979, 2000).

Research questions

The purpose of this study was to examine how the day of posting (early in the week vs. midweek vs. weekend) affects the level of critical discourse in CSCA. Messages posted late in the discussion period may be less likely to elicit responses due to limitations in time, attention, resources and visual displays. As a result, this study tested the following hypotheses:

1. Messages elicit more responses and critical discourse when posted earlier in the week within argument–challenge, challenge–counterchallenge, challenge–explain and challenge–evidence exchanges.

2. The effects differ across these four types of exchanges because the number of replies to challenges has been found to be affected less by delays in response time than the number of replies to other types of messages, like arguments (Jeong, 2004).

Method

Participants

The participants were graduate students (N = 72) from a major university in the south-east region of the USA, consisting of 46 females and 26 males and ranging from 20 to 50 years in age. The participants were enrolled in an online graduate introductory course on distance education (taught by the same instructor covering identical weekly topics in identical sequence) in fall 2004 (eight females, six males), spring 2005 (nine females, five males), fall 2005 (11 females, five males), spring 2006 (seven females, three males) and fall 2006 (11 females, seven males) terms.

Debate procedures

To examine responses generated across the four types of argumentative exchanges, the students in this study were presented a choice of message/response categories (Figure 1) to structure their discourse around—arguments with challenges, supporting evidence, explanations and challenges. Students are required to classify each posted

Label	Description of label	Example message by label
+	Identifies a message posted by a student assigned to the team supporting the given claim/statement	--
-	Identifies a message posted by a student assigned to the team opposing the given claim/statement	--
ARG#	Identifies a message that presents one and only one argument or reason for using or not using chats instead of threaded discussion forums). Number each posted argument by counting the number of arguments already presented by your team. Sub-arguments need not be numbered. ARG = "argument".	**-ARG1** One's choice of media makes very little difference in students' learning because the primary factor that determines level of learning is one's choice of instructional method.
EXPL	Identifies a reply/message that provides additional support, explanation, clarification, elaboration of an argument or challenge.	**-EXPL** As a result, media are merely vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition.
BUT	Identifies a reply/message that questions or challenges the merits, logic, relevancy, validity, accuracy or plausibility of a presented argument (ARG) or challenge BUT).	**+BUT** However, one's choice of media can affect or determine which instructional methods are or are not used. If that is the case, then choice of media can make a significant difference.
EVID	Identifies a reply/message that provides proof or evidence to establish the validity of an argument or challenge.	**-EVID** Media studies, regardless of the media employed, tend to result in "no significant different" conclusions (Mielke, 1968).

Figure 1: Message labelling instructions for the online debates
Note: ARG, argument, BUT, challenge; EVID, supporting evidence; EXPL, explanation.

Figure 2: Example debate with labelled messages in a Blackboard threaded discussion
Note: The names of students have been removed to protect students' identity.

message by category—often based loosely on Toulmin's (1958) model of argumentation—by inserting the corresponding label into the message headings, and restrict the content of each message to address only one category at a time. Given that the students had no prior experience using message labels and were not given prior training or opportunities to practice using the message labels, students were allowed to return to their messages to correct for noted errors in their labels. One debate from each course was randomly selected and coded by the investigator to test for errors in the students' labels. Overall percent agreement was 0.91, based on the codes of 158 messages (42 arguments, 17 supporting evidence, 81 challenges and 17 explanations), with a Cohen Kappa coefficient of 0.86.

No participation points were awarded for a given debate if a student failed to follow these procedures. Figure 2 illustrates how the labelled messages appeared in the discussion board. One discussion thread was designated for posting supporting arguments, and a second but separate thread (located below the first thread and not visible in Figure 2) was designated for posting opposing arguments. Figure 3 provides an excerpt from one of the debates to illustrate some of the messages that were coded for each message.

Students participated in four weekly team debates using threaded discussion forums in Blackboard (Version 6.3.1), a web-based course management system. Student participation in the debates and other discussions within the course contributed to 20% of the

Category	Message text
-ARG	Borje Holmberg's Theory of Interaction and Communication states that "learning pleasure supports student motivation" and "strong student motivation facilitates learning"(Simonson, p. 43). I would argue that compelling media and multi-media increases learning pleasure and thus facilitates student learning – Bob
+BUT	Bob, what research is available to support your statement "compelling media and multi-media increases learning pleasure and thus facilitates student learning"?
+EVID	"Extensive research findings indicate that no direct link has been established between delivery medium, level of interaction, and the effect of both on student achievement." Keast 1997. "...Kozma (1994) agrees with me that there is no compelling evidence in the past 70 years of published and unpublished research that media cause learning increases under any conditions. Like all other researchers who have made a careful study of the arguments and research studies (e.g., Winn,1990), he reaches a conclusion that is compatible with my claims (Clark, 1983)."
-BUT	From my perspective, Clarke's "Media Will Never Influence Learning" does not take into account the effect poor media has on learning. I have attended many a training session where the media was deplorable to say the least. While the content was there, I did not learn very much (if anything) because I was fighting the quality of the media. I would argue that if poor media can have detrimental effect, then good media can have positive effect on learning – Bob
-EXPL	Please refer to a report by Harold F. O'Neil, Univ. of Southern California, for the Office of Naval Research entitled "What Works in Distance Learning" Feb 23, 2003. The report offers a guideline (p. 37) for a multimedia strategy. I quote "People learn better from corresponding words and graphics (e.g., animation, video, illustrations, pictures) than from words alone". This report guideline is based on research conducted by R. E. Mayer and R. B. Anderson and published in the Journal of Educational Psychology 83, 484-490 and 84, 444-452. I would argue that more recent research is showing that multimedia contributes to learning. Thanks, Bob.
-EVID	Bob's -ARG5 talks to the research of Hilary Perraton in that multimedia provide more "effective" learning experiences. The pleasurability of the experience does support the effectiveness of the learning.

Figure 3: Example discussion thread generated by an argument posted in opposition to the claim 'media makes very little or no significant contributions to learning'
ARG, argument; BUT, challenge; EVID, supporting evidence; EXPL, explanation; +, posted by member on supporting team; –, posted by member on opposing team.

students' grade. Students were randomly assigned to one of two teams (balanced by gender) to either support or oppose a given position. In each debate, students were required to post a minimum of four messages. At the end of each debate, a poll was conducted to determine which team presented the strongest arguments in order to establish team competition and motivate student participation. The purpose of each debate was to critically examine design principles, concepts and issues such as the following: 'The Dick & Carey ISD model is an effective model for designing the instructional materials for this course', 'Type of media does not make any significant contribution to student learning', 'Given the following data, the country of NED should not develop a distance learning system', and 'Print is the preferred medium for delivering a course study guide'.

Data analysis

ForumManager (Jeong, 2006a) was used to download the labelled messages from the Blackboard discussions into Microsoft Excel. The discussion analysis tool (DAT) (Jeong, 2005, 2006b) extracted the message labels (ARG, BUT, EXPL, EVID) from message headings. All messages were then categorised into three groups: messages posted early in the week (Tuesday, Wednesday), midweek (Thursday, Friday) and on weekends (Saturday, Sunday). DAT tallied the frequency of responses elicited by each type of message (eg, number of challenges posted in reply to *each* argument posted in a given time period) to generate the raw scores used to test the effects of the day of posting.

The data consisted of 1602 messages. Figure 4 shows the message frequencies per category (by row) listed under 'givens', and the frequency of responses (by column) elicited by each message. The higher-than-expected frequencies of responses posted across the diagonal in the frequency matrix suggests that once messages were posted, the messages elicited the majority of responses within the next 1 or 2 days, and once responses were posted to the messages, there were fewer reasons or opportunities to post additional responses to these very messages later in the week.

Results

Main effects

The results of the 3×4 analysis of variance (day of posting $\times$ exchange type) showed significant differences in the number of responses between the day of posting, $F\ (2,\ 2702) = 54.17$, $p = 0.000$. Differences in the number of responses between exchange type was also significant, $F\ (3,\ 2702) = 203.60$, $p = 0.000$. The analysis also revealed that the effects of the time period depended on the type of exchanges, or vice versa, eliciting the responses, $F\ (6,\ 2702) = 14.94$, $p = 0.000$. Table 1 presents the mean number of responses observed in each time period per exchange type.

Post hoc analysis

Because the effects of the day of posting depended on the type of exchange eliciting the responses, post hoc analysis was conducted to determine which day of posting had the largest and the least impact on the number of responses elicited *within* the four types of exchanges (argument–challenge, challenge–counterchallenge, challenge–explain,

	1ARG	1BUT	1EXPL	1EVID	2ARG	2BUT	2EXPL	2EVID	3ARG	3BUT	3EXPL	3EVID	Replies	No Replies	Givens	% Replies	% Givens
1ARG	2	*84*	*51*	*42*	3	*47*	18	11	1	*28*	*9*	12	308	16	164	.27	.10
1BUT	0	*60*	10	14	0	48	11	*6*	0	47	*5*	*5*	206	84	240	.18	.15
1EXPL	0	*28*	*10*	5	0	*9*	9	4	0	*6*	*9*	*0*	80	34	92	.07	.06
1EVID	0	*19*	6	2	0	10	2	2	0	*6*	2	3	52	35	77	.05	.05
2ARG	-	-	-	-	*2*	*31*	*20*	*18*	*2*	26	9	8	116	18	87	.10	.05
2BUT	-	-	-	-	0	*60*	13	9	0	*52*	*4*	9	147	128	251	.13	.16
2EXPL	-	-	-	-	0	13	*10*	2	0	*19*	6	*0*	50	51	94	.04	.06
2EVID	-	-	-	-	0	*12*	2	*10*	0	10	1	2	37	34	68	.03	.04
3ARG	-	-	-	-	-	-	-	-	*3*	*12*	*7*	*7*	29	27	62	.03	.04
3BUT	-	-	-	-	-	-	-	-	0	*55*	*17*	*14*	86	217	315	.07	.20
3EXPL	-	-	-	-	-	-	-	-	0	*13*	*5*	2	20	57	80	.02	.05
3EVID	-	-	-	-	-	-	-	-	0	*15*	2	*4*	21	53	72	.02	.04
	2	191	77	63	5	230	85	62	6	289	76	66	1152	754	1602		

Figure 4: Message-response frequency matrix generated by DAT
Replies = observed number of replies posted to each message type. No Replies = number of messages that did not receive a reply; Givens = number of messages observed; Reply Rate = percentage of messages that elicited at least one reply. The frequencies shown in italics and bold were significantly greater than the expected frequency (1/12 categories = 0.083) based on z-score tests with $p < 0.05$. *Values shown in bold and underlined were significantly less than the expected frequency. ARG, argument; BUT, challenge; EXPL, explanation; EVID, supporting evidence; 1, posted early in the week; 2, posted midweek; 3, posted on the weekend.*

challenge–evidence). Furthermore, regression analysis was conducted to compare the effects of day of posting *between* each exchange type.

Challenges elicited per argument

The differences in the number of challenges elicited per argument between time periods were significant, $F(2, 305) = 9.18$, $p < 0.000$. The mean number of challenges elicited per argument was 0.90 ($SD = 0.99$, N = 163), 0.68 ($SD = 0.73$, N = 85) and 0.35 ($SD = 0.58$, N = 60) for arguments posted early in the week (Tuesdays, Wednesdays), midweek (Thursdays, Fridays) and on weekends (Saturdays, Sundays) respectively. As a result, the mean number of challenges elicited per argument posted early in the week was 31% higher than arguments posted midweek (effect size [*ES*] = +0.24), and more than 2.5 times higher than arguments posted on weekends (*ES* = +0.68). The mean number of challenges elicited by arguments posted midweek was approximately two times higher than arguments posted on weekends (*ES* = +0.51).

Counter-challenges elicited per challenge

The differences in the number of challenges elicited per challenge between time periods were significant, $F(2, 799) = 30.22$, $p < 0.000$. The mean number of counterchallenges elicited per challenge was 0.59 ($SD = 0.74$, N = 239), 0.41 ($SD = 0.62$, N = 251) and 0.20 ($SD = 0.42$, N = 312) for challenges posted early (Tuesdays, Wednesdays), midweek (Thursdays, Fridays) and on weekends (Saturdays, Sundays) respectively. As a result, the mean number of counterchallenges elicited per challenge posted early in the

Table 1: Mean number of responses observed within exchange type by time period

Exchange type	*Time period*	*Mean*	*SD*	*N*[a]
ARG → BUT	Tuesday–Wednesday	0.896	0.985	163
	Thursday–Friday	0.682	0.727	85
	Saturday–Sunday	0.350	0.577	60
	Total	0.731	0.874	308
BUT → BUT	Tuesday–Wednesday	0.594	0.744	239
	Thursday–Friday	0.414	0.623	251
	Saturday–Sunday	0.199	0.423	312
	Total	0.384	0.618	802
BUT → EXPL	Tuesday–Wednesday	0.075	0.264	239
	Thursday–Friday	0.036	0.186	251
	Saturday–Sunday	0.045	0.207	312
	Total	0.051	0.220	802
BUT → EVID	Tuesday–Wednesday	0.038	0.191	239
	Thursday–Friday	0.016	0.125	251
	Saturday–Sunday	0.006	0.080	312
	Total	0.019	0.136	802
Total	Tuesday–Wednesday	0.358	0.690	880
	Thursday–Friday	0.209	0.489	838
	Saturday–Sunday	0.099	0.319	996
	Total	0.217	0.526	2714

[a]This number represents the number of messages of a given category that *initiated* the exchange (not the number of times a specific message-response exchange was observed). For example, the 239 BUT messages posted on Tuesday and Wednesday elicited a total of 142 (239 × 0.594) BUT responses. As a result, the number of observed message-response exchanges can be computed by multiplying N × Mean.
ARG, argument; BUT, challenge; EXPL, explanation; EVID, evidence.

week was 43% higher than challenges posted midweek (*ES* = +0.26) and three times higher than challenges posted in the weekends (*ES* = +0.65). The mean number of counterchallenges elicited per challenge posted midweek was approximately two times higher than challenges posted on weekends (*ES* = +0.41).

Explanations elicited per challenge

The differences in the number of explanations elicited per challenge between time periods were not significant, $F(2, 799) = 2.17$, $p < 0.114$. The mean number of explanations elicited per challenge was 0.08 (*SD* = 0.26, N = 239), 0.04 (*SD* = 0.19, N = 251) and 0.05 (*SD* = 0.21, N = 312) for challenges posted early in the week (Tuesdays, Wednesdays), midweek (Thursdays, Fridays) and on weekends (Saturdays, Sundays) respectively. As a result, the mean number of explanations elicited per challenge posted early in the week was approximately two times higher than challenges posted midweek (*ES* = +0.17) and more than 2.7 times higher than challenges posted on weekends (*ES* = +0.13). The mean number of explanations elicited per challenge posted midweek was approximately 20% less than challenges posted on weekends (*ES* = –0.05).

Supporting evidence elicited per challenge

The differences in the number of replies with supporting evidence elicited per challenge between time periods was significant, $F(2, 799) = 3.70$, $p < 0.025$. The mean number of replies with supporting evidence elicited per challenge was 0.038 ($SD = 0.19$, N = 239), 0.016 ($SD = 0.13$, N = 251) and 0.006 ($SD = 0.08$, N = 312) for challenges posted early in the week (Tuesdays, Wednesdays), midweek (Thursdays, Fridays) and on weekends (Saturdays, Sundays) respectively. As a result, the mean number of replies with supporting evidence elicited per challenge posted early in the week was more than 2.3 times higher than challenges posted midweek ($ES = +0.14$) and more than 6.3 times higher than challenges posted on weekends ($ES = +0.21$). The mean number of replies with supporting evidence elicited per challenge posted midweek was more than 2.6 times higher than challenges posted on weekends ($ES = +0.09$).

Regression analysis

Further analysis revealed that the day of posting had the greatest effect on ARG–BUT exchanges, had less effect on BUT–BUT exchanges, and had little or no effect on BUT–EXPL and BUT–EVID exchanges. Figure 5 illustrates the differences in the rate of change in the number of target replies elicited per given message between exchange types. Arguments posted on the first versus second day of discussion elicited an average of 1.38 versus 1.20 challenges per argument, with the number of elicited challenges dropping an average of 12% per day (Pearson $r = -0.346$, $p = 0.000$). In contrast, the mean number of counterchallenges elicited per challenge dropped an average of 11.6% per day (Pearson $r = -0.31$, $p = 0.001$), the mean number of explanations elicited per

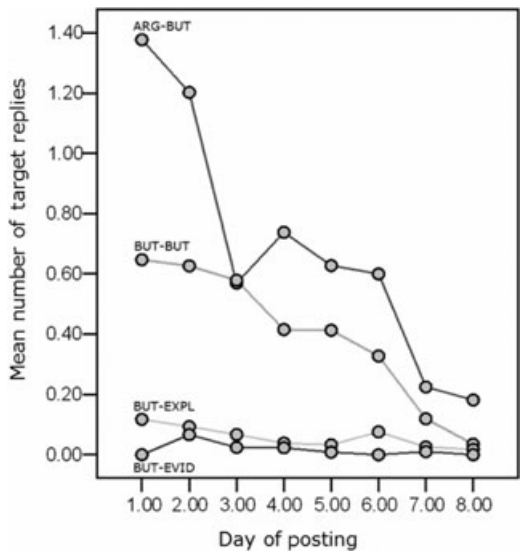

Figure 5: Rate of change in number of elicited replies across day of posting
ARG, argument, BUT, challenge; EVID, supporting evidence; EXPL, explanation.

challenge dropped by 9.9% per day (Pearson $r = -0.08$, $p = 0.013$), and the mean number of supporting evidence elicited per challenge dropped by 13.3% per day (Pearson $r = -0.096$, $p = 0.000$). The rate of change (or slope) between each of the six possible pairing of exchange types (eg, ARG–BUT vs. BUT–BUT, ARG–BUT vs. BUT–EXPL, etc) were significantly different based on the tests for interaction between exchange types and day of posting using univariate analysis of variance (all with $p \leq 0.001$). Worth noting is that the sudden drop in response rates on day 6 in three of the four exchange types were most likely due to lower student participation generally observed on all Saturdays across all class discussions in the online course.

Discussion

The purpose of this study was to examine how messages posted early in the week versus midweek versus weekend affected the number of responses observed within argument–challenge, challenge–counterchallenge, challenge–explain and challenge–evidence exchanges. This study found significant differences between the day of posting in the number of responses generated across the four types of exchanges. Furthermore, this study found that the effects of the day of posting depended on the type of exchange, with the most rapid decrease in replies observed in argument–challenge exchanges, moderate decreases in replies in challenge–counterchallenge exchanges, and minimal decreases in replies in challenge–explain and challenge–evidence exchanges. Significant differences were found in the number of replies posted early in the week versus midweek versus weekend observed within the argument–challenge, challenge–counterchallenge and challenge–evidence exchanges, while no significant differences were observed within the challenge–explain exchanges. Overall, these findings are consistent with the findings of previous studies (Hewitt & Teplovs, 1999; Jeong, 2006a), which show that the longer students wait to post a response, the less likely a response will elicit reciprocating responses from other students.

One explanation for the large decrease in replies observed in argument–challenge exchanges is that arguments posted late in the week were displayed at the bottom of each thread designated for posting supporting and opposing arguments (when using Blackboard's default display format). As a result, arguments posted on the weekend, for example, were displayed in a location that was not as visually prominent as arguments posted early in the week (arguments displayed at the top of the page). However, the rate of decrease in replies posted in challenge–counterchallenge exchanges was not as severe, because many of the challenges posted on the last day of discussion, for example, were posted in reply to early arguments and were therefore displayed at or near the top of the forum along with the early arguments. As a result, counterchallenges posted in reply to challenges in general were displayed throughout the forum and therefore were less affected by the combined effects of the day of posting and visual prominence. The effects of the day of posting on replies posted in challenge–explain and challenge–evidence exchanges were negligible because explanations and supporting evidence could also be posted in reply to early arguments (and displayed at or near the top of the forum in a visually prominent position), and because explanations and supporting evidence were posted in reply to challenges at relatively low frequencies.

The implications of these findings on how to foster more critical discussion in CSCA (and perhaps in CMC in general) are clear: (1) establish deadlines to post all arguments and subsequent deadlines to discuss all arguments; (2) conduct discussions over longer periods of time (with established deadline for posting arguments) to eliminate the challenges that multiple deadlines impose on learners whom require flexible work/study schedules; or (3) post all arguments (or as many as possible) in advance so that discussions on each argument begin on the same day; and (4) remind students to pay equal attention to arguments displayed near the bottom of the discussion forum.

As for the possible implications on how to design the next generation of online discussion environments, the findings suggest the following: (1) collapse all threads when students first enter a discussion forum so that all arguments are displayed on screen; or (2) provide tools to automatically collapse discussion threads at a specified thread level; (3) display the number of new unread responses posted within each collapsed thread; and (4) present the newest arguments or arguments with the fewest responses (or shortest thread) at the top of the page or at the top of the list of arguments nested within the discussion threads designated for posting supporting versus opposing arguments.

Due to limitations in the scope and design of this study, these findings are not conclusive. Future studies will need to examine the day of posting and its effects: (1) in less structured tasks (without message or time constraints, assigning students to debate teams and requiring number of postings); (2) with smaller discussion groups; (3) across nonadversarial exchanges (eg, argument–explain and argument–evidence); and (4) on individual and group learning outcomes (eg, decision making, problem solving).

Although this study did not directly test the effects of visual prominence (work in progress), this study provides an insightful and in-depth look into some of the limitations of asynchronous discussions, in spite of the common belief that asynchronous discussions are generally time-independent. The findings and methods described in this study provide directions for future research that will help us better understand the link between the affordances of CMC (eg, time-independence), its visual and functional characteristics, the processes of group communication and critical discourse, and quality of online discussions. Ultimately, future research on these aspects of CMC (using the methods illustrated in this study) will provide the basis for developing a deeper and better understanding of the differences in affordances between CMC and other emerging communication technologies (eg, Wikis and blogs) and their effects on group performance.

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